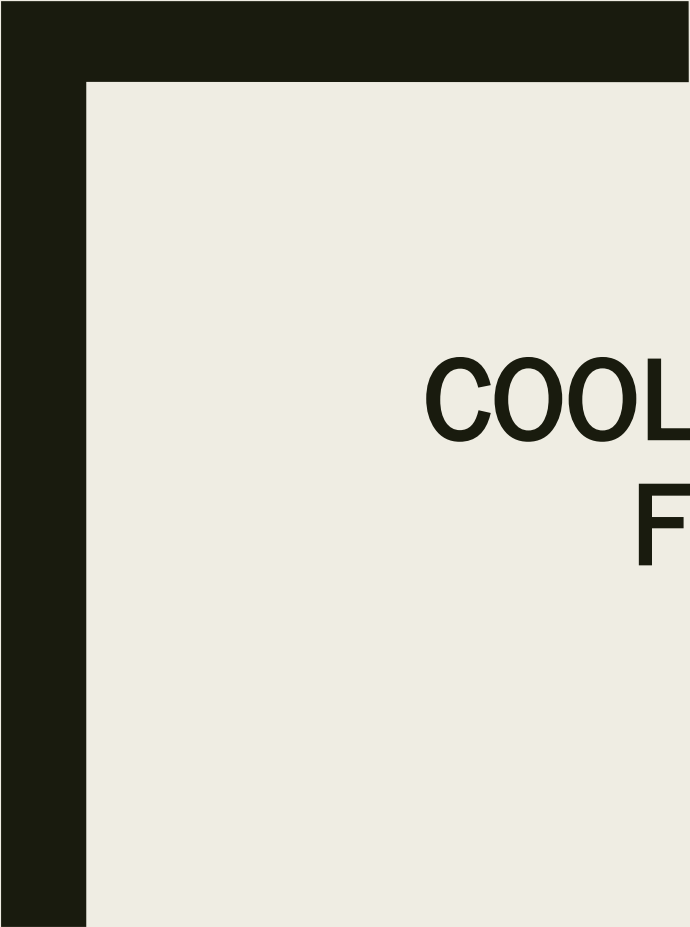




CALCULATING COOLING REQUIREMENTS FOR DATA CENTER

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What we need to focus?

- Estimate heat output from information technology (IT) equipment and other devices in a data center such as UPS, Light etc.
- A number of common conversion factors
- Design guideline values
- Sizing air conditioning systems.

Cooling Requirements for Data Centers

- Equipment in Data Center produces heat, should have a better way to remove.
- Most IT Product in a data center or network room should be air-cooled.
- Need better understanding of the amount of heat produced by the equipment contained in the enclosed space, along with the heat produced by the other heat sources.

Google data center in Hamina, Finland



Sea water cooling system.

Facebook's Second European Data Center in Clonee, Ireland



For cooling, Clonee will use a system to filter the air more thoroughly than in other places before it can be used inside the building because there's too much salt in the air.

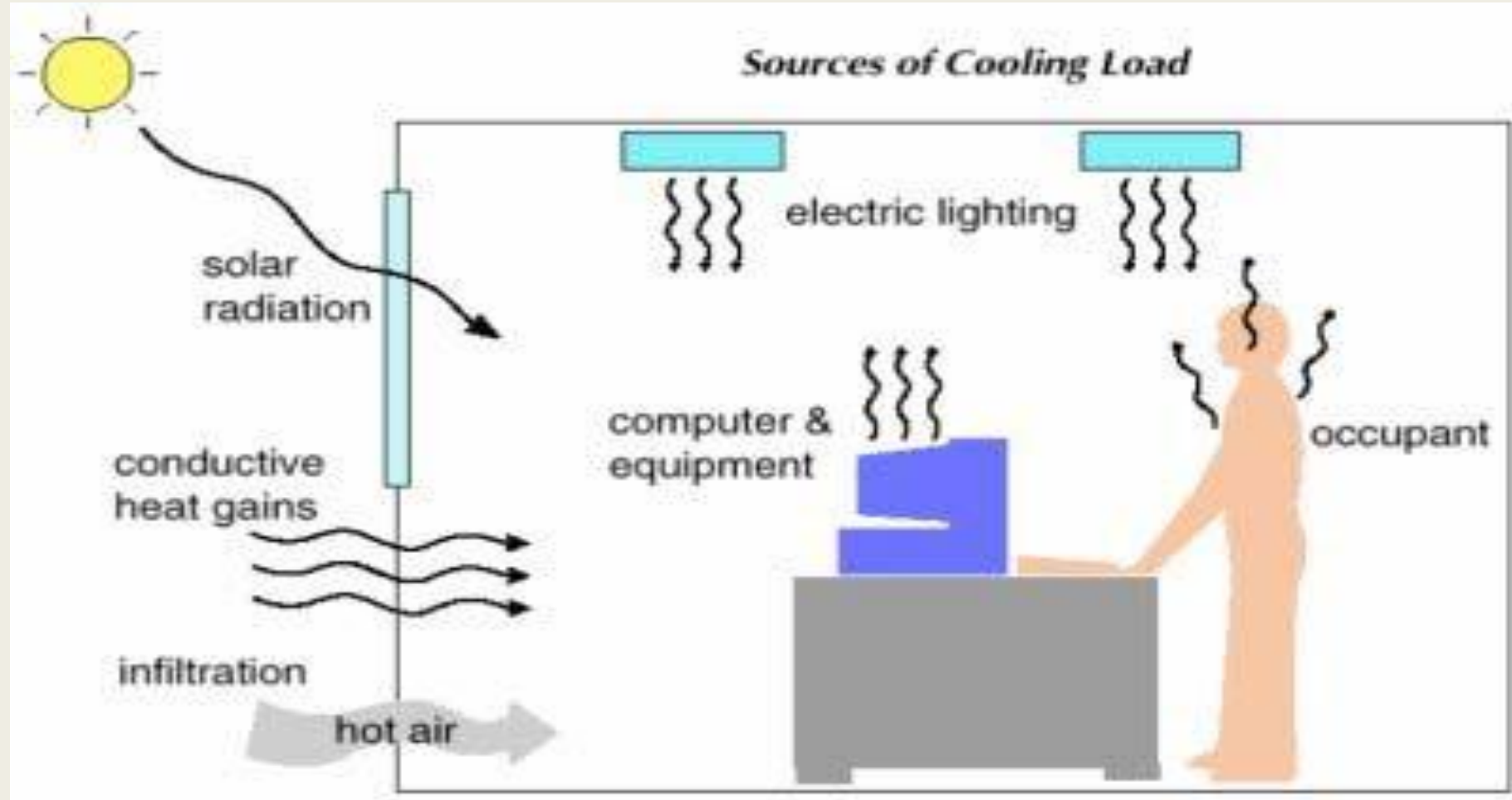
Measuring heat output

- Joules
- BTU,
- Tons,
- Calories

Unit Conversions

Given Value	Multiply By	To Get
BTU/hour	0.293	Watts
Watts	3.41	BTU/hour
Tons	3,530	Watts
Watts	0.000283	Tons

Components of Heating Load



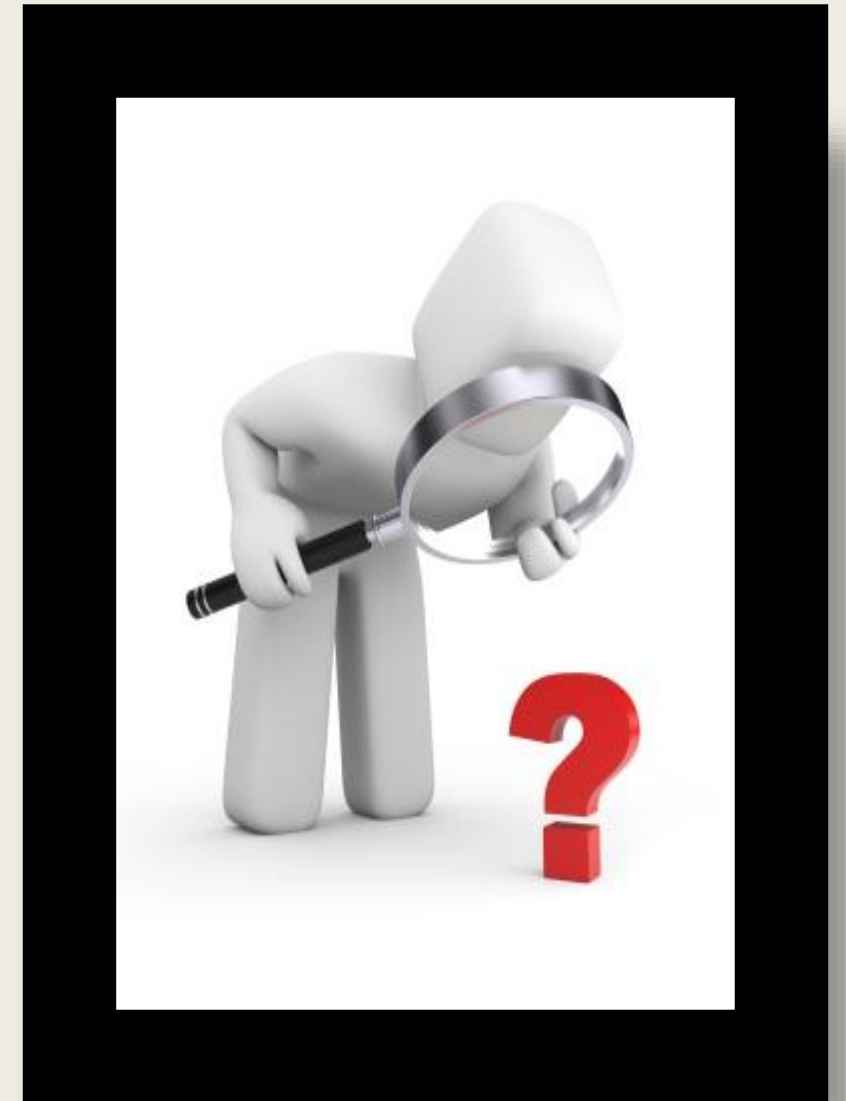
How to Find Heat Output?

$$\sum H \approx h_1 + h_2 + h_3 + h_4 + \dots$$

H=Total Heat Output.

Heat Output of all components includes:

- ☐ IT Equipment
- ☐ UPS
- ☐ PDU
- ☐ AC
- ☐ Lighting
- ☐ People



Determining heat output of a complete system

- The heat output of UPS and power distribution systems consists of a fixed loss and a loss proportional to operating power.
- Lighting and people can also be readily estimated using standard values.
- Air conditioning units create a significant amount of heat from fans and compressors. This heat is exhausted to the outside and does not create a thermal load inside the data center.

Humidification

- Humidity describes the amount of water vapor in air
- To removing heat, an air conditioner system for a data center is designed to control humidity.
- When the desired humidity is attained, the system would operate with a constant amount of water in the air.
- Most air conditioning systems the air-cooling function of the air conditioning system causes significant condensation of water vapor and consequent humidity loss.

Humidification in the computer centers



Air Humidification



Clean Steam & Humidification

Case Study: Heat Output Calculation

Item	Data required	Heat output calculation	Heat output subtotal
IT equipment	Total IT load power in Watts	Same as total IT load power in watts	_____ Watts
UPS with battery	Power system rated power in Watts	$(0.04 \times \text{Power system rating}) + (0.05 \times \text{Total IT load power})$	_____ Watts
Power distribution	Power system rated power in Watts	$(0.01 \times \text{Power system rating}) + (0.02 \times \text{Total IT load power})$	_____ Watts
Lighting	Floor area in square feet, or Floor area in square meters	$1.33 \times \text{floor area (sq ft)}$ 3, or $14.32 \times \text{floor area (sq m)}$	_____ Watts
People	Max # of personnel in data center	$100 \times \text{Max \# of personnel}$	_____ Watts
Total	Subtotals from above	Sum of heat output subtotals	_____ Watts

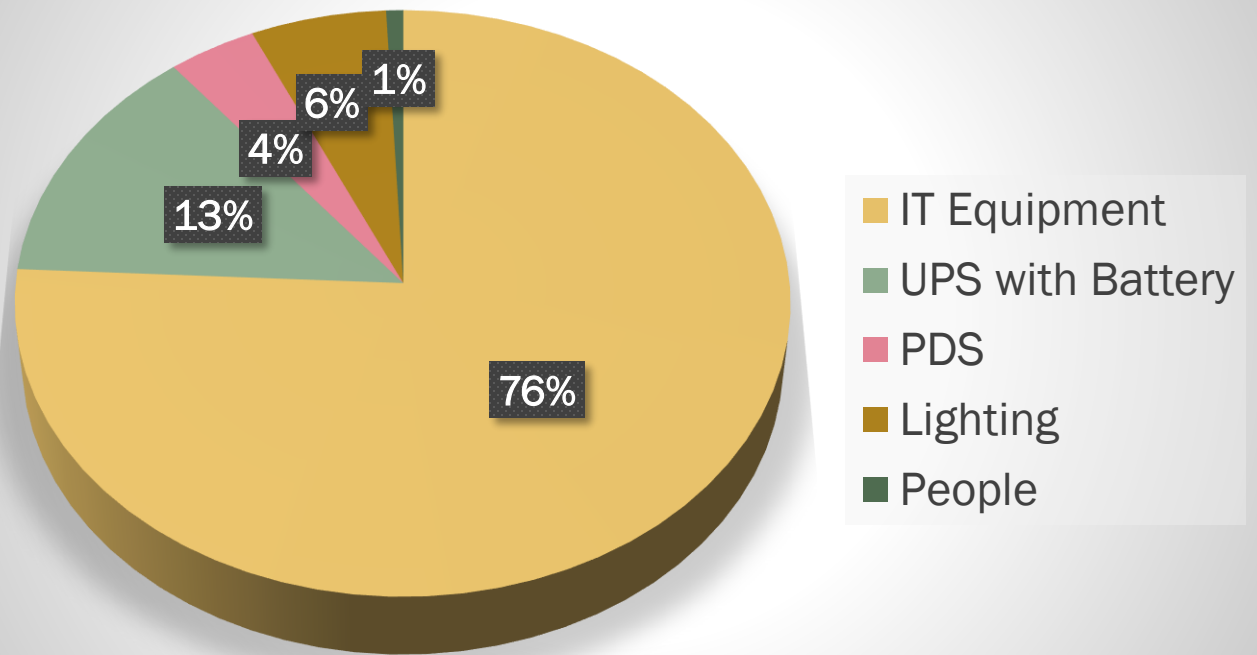
Case Study : Heat Output Calculation

Item	Data required	Heat output calculation	Heat output subtotal
IT equipment	Total IT load power in Kilo Watts	50KW	50000 Watts
UPS with battery	Power system rated power in Kilo Watts	$(0.04 \times 160) + (0.05 \times 50)$ $= (6.4 + 2.5) = 8.9\text{KW}$	8900 Watts
Power distribution	Power system rated power in Kilo Watts	$(0.01 \times 160) + (0.02 \times 50)$ $= (1.6 + 1) = 2.6\text{KW}$	2600 Watts
Lighting	Floor area in square feet	$1.33 \times 3000 / 1000$	3990 Watts
People	Max # of personnel in data center	100×5	500 Watts
Total	Subtotals from above	Sum of heat output subtotals	65990 Watts or 66 Kilo Watts

Case Study :Heat Output Ratio

The thermal output of a typical system is described. A 3,000 SFT, (279 m2) 250 kW rated data center with 20 racks and a maximum staff of 5 is used as an example.

Graph View of Heat Output



Sizing of Air Conditioning

- Concepts and fundamentals of air conditioner sizing is based on heat gain, and/or losses in a building.
- It is obvious that you will need to remove the amount of heat gain - if it is hot outside. Similarly, you'll need to add in the heat loss from your space - if outside temperature is cold.
- In short, heat gain and loss, must be equally balanced by heat removal, and addition, to get the desired room comfort that we want.

Sizing of Air Conditioning(Contd.)

- The Watt loads of each of these factors can be summed to determine the total thermal load.
- Expressing all measures of power and cooling in Watts simplifies the process.
- To cool a room or building its output must be greater than the heat gain.
- Cooling Load or Air Conditioning Size $\geq$ Heat or Thermal Load
- A general rule is that a CRAC(Computer Room Air Conditioning) system rating should be 1.3 times the anticipated IT load rating plus any capacity added for redundancy.
- Approximate cooling size of the mentioned Data Center is not less than 66 KW or 19 Ton

Summary

Once the cooling requirements are determined, it is possible to size an air conditioning system. The following factors should be considered:

- ☐ The size of the cooling load of the equipment (including power equipment)
 - ☐ The size of the cooling load of the entire Data Center
 - ☐ Oversizing to account for humidification effects
 - ☐ Oversizing to create redundancy
 - ☐ Oversizing for future requirements
- The Watt loads of each of these factors can be summed to determine the total thermal load.



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THANK YOU!

Any questions?